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Species Groups Follow Patterns Similar to Individual Species Reacting to Climate Change on Northeast Shelf

Researchers studying marine fishery species grouped by similar depth and temperature distribution have found that those groups have similar responses to the effects of climate change. Interactions between individual species in those groups, however, may be affected by the amount of available habitat, predator-prey relationships, and competition for food resulting from shifts in range and distribution.

The study, published today in PLOS ONE, evaluates the pace and magnitude of climate change effects for bottom-dwelling fishery species found on the U.S. Northeast Shelf. Nearly 70 species were classified into four distinct "assemblages" or groups of species sharing a common environmental niche – in this case temperature, depth and seasonal movement. The groups occurred in one of two distinct sub-regions of the Northeast Shelf. The northern region was defined as the semi-enclosed Gulf of Maine, and the southern region as the broad, shallower Mid-Atlantic Bight and Georges Bank.

"Regional differences in the effects of climate change on the movement and extent of species assemblages hold important implications for management, mitigation of climate change effects, and adaptation," said lead author Kristin Kleisner of the Northeast Fisheries Science Center (NEFSC)'s Ecosystem Assessment Program. "A number of studies have looked at impacts on individual species on the U.S. Northeast Shelf, but no one has really looked at how the ecosystem is affected at the assemblage level. Local climate variability plays a major role, as do topography and oceanographic conditions."

The study hypothesized that groups of species characterized by similar temperature and depth distribution would exhibit similar responses to climate effects. The team compared observed historical shifts in species distributions with concurrent shifts in temperature to determine whether consistent responses to climate change were visible within the species groups. The historical data examined was collected during the NEFSC's spring and fall bottom trawl surveys from 1968 to 2012.

Researchers found consistent patterns in the direction and rate of distribution shifts within the species assemblages in each region. Species associated with warmer, shallower waters in the Mid-Atlantic Bight and Georges Bank were shifting strongly northeast, tracking shifts in temperature bands along the shelf.

In contrast, species associated with shallower, warmer waters in the Gulf of Maine were shifting to the southwest, possibly tracking the cooler bottom waters in this area of the Gulf.

Species in the Gulf of Maine associated with cooler and deeper waters also tended to shift deeper, taking advantage of the variable bottom topography in this region, but with little latitudinal change. Shifts in depth among the southern species associated with deeper and cooler waters are more variable, although predominantly shifts are toward deeper waters.

"Changes in the assemblage or group ranges that correspond to changes in the availability of desired temperature areas have consequences for species interactions and the level of fishing effort concentrated on fish stocks," said Kleisner. "The ability to distinguish regional climate responses at the community level provides important information for ecosystem-based fisheries management."

Differences in how species respond to regional climate changes may have implications for predator-prey interactions and competition as species shift into new areas and undergo range expansion or contraction. Fisheries management implications include new species entering or leaving traditional habitats. Increasingly concentrated species, for example, could result in increased vulnerability to capture by fishing, and potentially a decline in abundance.

Along the Mid-Atlantic Bight, economic impacts will be felt as shifting distributions of traditionally harvested species alter patterns of their availability to local fishing communities. The result is lost access to stocks managed with species-specific quotas, and rising fuel and travel costs as vessels seek out species in more distant areas.

"This study represents an important advance in our understanding of changes in fish assemblages in recent decades. The Nature Conservancy looks forward to continuing to work with researchers and managers to put this knowledge to work for the benefit of people and nature," said Sally McGee, Northeast Marine Program Director for the Nature Conservancy and one of the paper's co-authors.

The study was conducted through a joint partnership between NOAA's Northeast Fisheries Science Center and The Nature Conservancy, and was funded by a grant from the Gordon and Betty Moore Foundation.

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Related links:

PLOS ONE article: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0149220

Northeast Climate Vulnerability Assessment:
http://www.nefsc.noaa.gov/press_release/pr2016/scispot/ss1603/

NEFSC's Fisheries and Climate web site: http://www.nefsc.noaa.gov/fisheries-climate/

Northeast U.S. continental shelf ecosystem: http://www.nefsc.noaa.gov/ecosys/